EL Program: Smart Grid

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Strategic Goal: Smart Manufacturing, Construction, and Cyber-Physical Systems

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Summary: This program develops and implements measurement science underpinning modernization of the Nation's electric grid in order to improve system efficiency, reliability and sustainability, by incorporating distributed intelligence, bi-directional communications and power flows, and additional advancements to create a smart grid. In response to a mandate given by Congress and the Administration, NIST, through its Engineering Laboratory-led Smart Grid program and public-private Smart Grid Interoperability Panel (SGIP), is leading the coordination and acceleration of smart grid interoperability and security standards in collaboration with the private sector and has published the NIST Framework and Roadmap for Smart Grid Interoperability, which provides the foundation for future work. By utilizing expertise in NIST's Engineering, Physical Measurement and Information Technology Laboratories, this program will advance the measurement science that will increase asset utilization and efficiency, improve grid reliability, and enable greater use of renewable energy sources in the grid through research, standardization, testing and implementation of the NIST Framework.

DESCRIPTION

Objective: To develop and deploy advances in measurement science to enable integration of interoperable and secure real-time sensing, control, communications, information and power technologies, in order to increase efficiency, reliability and sustainability of the nation's electric grid, by 2016.

What is the problem? The electric grid is not capable, in its present state, of meeting the increasing demands of the 21st century economy for cost-effective, highly reliable, and sustainable electric energy. It is estimated that $1.5 - $2 trillion will be needed to replace existing aging transmission, generation and distribution assets and accommodate growth in demand over the next 20 years. The national scale and importance of the problem and the drivers to modernize the nation's electrical grid through development of a smart grid are recognized in many policy documents, including the Energy Independence and Security Act of 2007 (EISA),[1] State of the Union addresses reiterating the President's vision for the clean energy economy,[2] the White House's "Blueprint for a Secure Energy Future,"[3] and the National Science and Technology Council (NSTC) report "A Policy Framework for the 21st Century Grid: Enabling Our Secure Energy Future."[4]

Because the present system is designed to meet infrequent peak demands, it operates inefficiently, at roughly 50% load factor on average. Improving system efficiency and reducing peak usage by managing demand as well as generation can reduce investments that would otherwise be needed with business as usual. The reliability of the U.S. grid is an order of magnitude worse than that of some other developed countries such as Japan and Korea, imposing an estimated $80 billion to $100 billion in yearly economic losses to the U.S. economy.[5] Electricity generation accounts for 40% of human-caused CO_2 emissions, and renewable energy portfolio standards have been enacted in 29 states to drive more sustainable clean generation. The grid will have to be capable of more dynamic operation to support integration of significant amounts of intermittent renewable energy sources such as wind and solar, which currently account for less than 5% of U.S. generation capacity.

The overarching problem is that measurement science is lacking (1) to improve cross-cutting systems-level smart grid performance; (2) to enable real-time sensing and control of transmission and distribution grids; (3) to manage integration of new distributed energy resources throughout the grid; and (4) to fully integrate customer facilities with a smart grid. Integration of new sensor, communications, control and optimization technologies into the electric grid is critical to addressing these problems; however grid operators and regulators have been slow to adopt them at large scale because the measurement science to ensure expected benefits are realized is lacking. Technical barriers to their adoption include incomplete standards and testing programs for interoperability of smart grid devices and systems, concerns about cybersecurity, and lack of validated measurement methods and models that demonstrate that new smart grid technologies cost-effectively improve grid performance without introducing unforeseen instabilities and vulnerabilities.

Why is it hard to solve? The existing U.S. electric power grid is a complex and fragmented assembly of systems and operators, with complicated regulatory oversight and market structures governing a collective infrastructure investment of over $1 trillion. The grid is operated by 3200 electric utilities, delivering power to 140 million customers, with equipment and systems provided by hundreds of suppliers, and many diverse stakeholder groups whose needs must be satisfied. In addition, with the absence of economical grid-scale electric storage, generation and consumption of electricity must be coordinated and balanced in real time, with large deviations causing blackouts and brownouts across regions of the grid.

Integrating new distributed intelligence, communications and control technologies and new operating paradigms in a large, complex system that must continue without interruption is a significant technical challenge, requiring robust, fully tested solutions based on interoperable and secure equipment and systems. Improving smart grid systems-level performance is hard because of lack of coordination and validation of integrated modeling of the multiple interconnected systems and subsystems, including at different time scales and abstraction levels together with significant physical and cybersecurity requirements. It is difficult to implement distributed sensing and control into transmissions and distribution grids because of the need to characterize the dynamic performance of equipment and sensors that are both cost-effective and operational under challenging field environments. It is hard to accommodate large amounts of intermittent distributed energy resources into the grid because the existing grids were not designed for two-way power flows, and required changes will substantially modify existing operations and safety procedures. A major paradigm shift for the grid is the automated management of demand as well as generation to optimize asset utilization and accommodate intermittent variable generation. The residential sector has little history of automation, and existing standards and control technology used in commercial and industrial facilities were not designed for interactions with a smart grid. In addition, significant technical challenges remain to model the bidirectional interactions between interacting subsystems and the smart grid in buildings and commercial and industrial facilities.

How is it solved today, and by whom? The challenging measurement science problems facing the smart grid have not been solved. Beyond NIST, smart grid research is conducted by Department of Energy (DOE) and its National Laboratories, utility suppliers, private institutes such as the Electric Power Research Institute and academia. The DOE programs (including DOE-supported academic research) are focused mainly on technology development and demonstration projects. Industry R&D is mostly product-oriented. NIST's research is uniquely focused on measurement of grid devices and systems, protocols and standards for interoperability, and cybersecurity – for example, NIST's electrical metrology has been the reference for accuracy of individual grid elements such as electric meters and phasor measurement units. The NIST Framework and Roadmap for Smart Grid Interoperability Standards[6] is the primary reference for interoperability protocols and standards, not only for the U.S. but also internationally – it has been used by Japan, Korea, China and the EU in developing their roadmaps. NIST's Guidelines for Smart Grid Cyber Security (NISTIR 7628)[7] is also cited internationally. While standards have been identified, many of them have not yet been validated through real-world performance. Few testing programs exist to ensure products and systems conform to standards, and are interoperable and secure. Validated system-level models that can be used to predict, measure and optimize smart grid performance and build confidence that expected benefits will be realized do not yet exist.

Why NIST? Through EISA, NIST is charged with "primary responsibility to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of smart grid devices and systems …"[8] Having developed a Framework and successfully engaged hundreds of private and public sector stakeholders by establishing the Smart Grid Interoperability Panel (SGIP), NIST has a unique opportunity to leverage the underlying capabilities in multiple Laboratories to advance the measurement science needs for the smart grid. This is consistent with the Engineering Laboratory (EL) strategic goal/objective to enable the next generation of innovative and competitive manufacturing, construction, and cyber-physical systems through advances in measurement science. Additionally, the Smart Grid program contributes to sustainable and energy efficient manufacturing, materials, and infrastructure, particularly through embedded intelligence in buildings and net-zero energy high performance buildings. The primary EL core competencies leveraged by the Smart Grid program are systems integration, engineering, and processes for cyber-physical systems and intelligent sensing, control, processes, and automation for cyber-physical systems, with additional support from the EL core competency of energy efficient and intelligent operation of buildings with healthy indoor environments.

What is the new technical idea? The key technical idea is the development of a standards-based reference architecture, with associated interoperability and security requirements, as the foundation for prioritizing and addressing measurement science needs for the smart grid. This architectural framework is described in detail in the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0 and Release 2.0. By combining a focus on interoperability with traditional NIST expertise in measurement characterization, NIST will develop the necessary measurement science deliverables, including standards, protocols, models, and test methods to ensure that the performance of the smart grid at the system, subsystem, and end-user levels can be measured, controlled, and optimized to meet interoperability, security, efficiency, reliability and other performance requirements. To accomplish this, system-level standardized architectural concepts, data models and protocols integrated with new measurement methods and models will be characterized or developed to sense, control and optimize the smart grid's new operational paradigm. To improve transmission and distribution operations, the new technical idea is to develop the measurement science to support real-time monitoring of grid functions through multiple measurement/sensor network systems to produce actionable information for grid operators. New power electronics performance characterization will be developed to evaluate and integrate power conditioning systems to support distributed energy resources in the grid. For user-to-grid interactions, the approach will be to model the interaction of complex building systems with the grid in a holistic, integrated manner that considers system interactions and their impact on energy consumption, comfort, safety, and maintenance.

Why can we succeed now? Congressional and Administration mandates and continued support provide a clear policy framework that ensures alignment of stakeholders on objectives to be achieved, coordination among federal, state and local government agencies, commitment and leverage of government and private sector resources, and regulatory support. They also provide clear authority for NIST to convene stakeholders in a collaborative process to develop solutions to measurement science problems, and extensive industry engagement is in place. NIST leadership is globally recognized, and collaboration with international partners is in place, allowing the NIST effort to benefit from experience gained through smart grid development in other countries. Initial smart grid deployments are underway supported by $4.5 billion of DOE smart grid investment and demonstration matching grants, providing a source of real-world data for NIST measurement science research.

What is the research plan? The smart grid research plan consists of interrelated projects to advance measurement science to enable the implementation of new smart grid functionality that: improves grid reliability; increases asset utilization and efficiency; and enables greater use of renewable energy sources in the grid. The projects are organized into five program thrust areas. These are: a systems-level cross-cutting Measurement Science for Smart Grid System Performance research thrust; three domain-focused research thrusts: Measurement Science for Transmission and Distribution Grid Operations; Measurement Science for Distributed Energy Resources and Microgrids, and Measurement Science for User-to-Grid Interoperation; and the Smart Grid National Coordination function within the EL Smart Grid and Cyber-Physical Systems Program Office. The three domain thrusts develop enabling measurement science for robust sensing, power management and communications and intelligence within their domains, and the overarching system-level thrust supports system-level coordination, evaluation and use of these underlying domain capabilities under grid-scale operating conditions and addressing the cross-cutting security, network communications and electromagnetic environment. The Smart Grid National Coordination function continues its leadership role in engaging all key stakeholders in the smart grid community to ensure NIST smart grid program deliverables meet their needs. Below, each program area and its constituent projects are described including interrelationships, with additional detail and deliverables for individual projects provided within the associated project descriptions. With respect to safety, research performed within the different program areas is carried out under the safety policies and operations of the respective Laboratory with assigned responsibly for the physical laboratory space; relevant hazard review and other information is covered within the associated project descriptions.

Program Area: Measurement Science for Smart Grid System Performance
This thrust area includes five projects that provide the needed measurement science to support cross-cutting, systems-level analysis and operational needs. The projects' deliverables enable actionable intelligence and decision-support modeling tools for grid-scale operators and provide the framework and tradeoff analyses for integration of domain-specific measurement science advances into overall grid operations, including addressing cybersecurity, understanding of network requirements, and acceptable performance within complex electromagnetic environments.

The Smart Grid Testing and Certification project develops the testing and certification framework for smart grid interoperability and ensures that the many different testing/certification efforts and directly associated standards are coordinated at the national and international level within the SGIP.

The Cybersecurity for Smart Grid Systems project leads the coordination of Cyber Security Working Group in the SGIP and enables the development of industry standards and guidance to successfully implement secure Smart Grid technologies, with cybersecurity and privacy addressed throughout development cycles to avoid need to retrofit security into products. To support SGIP Catalog of Standards evaluations and gain information on current state of security within existing standards, a focus of FY13-14 efforts will be to review key standards against the requirements in the NIST Guidelines to Smart Grid Cyber Security (NISTIR 7628), and to design and build a cybersecurity conformity testing framework.

The Smart Grid Communication Networks project provides smart grid users with guidance and tools to help make informed decisions about smart grid communication network infrastructures. In FY13-14, this project will develop and evaluate system-level models of smart grid communications, which will also support other thrust areas. Networks rely on time synchronization capabilities, as addressed by the Precision Timing for Smart Grid Systems project, which will develop performance, conformance and interoperability test methods for the IEEE 1588 Power Profile, in FY13-14.

The Electromagnetic Compatibility of Smart Grid Devices and Systems project develops the measurement science to support development and operation of smart grid equipment and systems in normal and "black swan" electromagnetic environments. In FY13, the focus of this effort will be to develop electromagnetic compatibility (EMC) methodology for priority concerns such as smart meters, wireless systems, broadband over power line, and others. In FY14, additional effort will focus on development of integrated smart grid specific radio-frequency measurements including an initial test-bed, with documented results and input provides to relevant standards development organizations (IEC, IEEE).

The Smart Grid System Testbed Facility Project is taking initial steps in FY13 to plan and establish (FY13-14) initial modules of an integrated smart grid system measurement testbed. The testbed will provide NIST the technical capability to simulate advanced smart grid systems comprised of multiple heterogeneous subsystems and validate advanced modeling and analysis tools.

Program Area: Measurement Science for Transmission and Distribution Grid Operations

This thrust area's two projects provide the measurement science to enable real-time situational awareness needed by grid operators. The projects aim to develop standards to support communication of actionable information from grid sensors, and new measurement methods to optimize the capabilities of these sensors to support grid operations. The Wide-area Monitoring and Control of Smart Grid project addresses measurement science and standards supporting deployment of Phasor Measurement Units (FY13) and new Phasor Data Concentrators (FY14) being deployed by utilities across the country in transmission grids. The Advanced Metering in Smart Distribution Grids project is focused on the measurement accuracy performance and role of smart meters as distributed end-node sensors in distribution grids, with FY13 focus on creating a testbed to support high-accuracy testing of meters, and extending (FY14) these tests to cover smart meters with auxiliary communications devices. A key linkage with the Smart

Grid Systems Performance thrust is that accurate characterization of the electromagnetic environments in which these meters must operate is an important input to this project.

Program Area: Measurement Science for Distributed Energy Resources and Microgrids
The initial project in this thrust area, the Power Conditioning Systems for Renewables and Storage project, addresses key measurement and standards barriers impeding deployment of distribution energy resources. Measurement science will be developed to support characterization and integration of advanced power electronic conditioning systems (PCS) to provide dispatchable smart grid-enhanced interfaces for distributed energy resources and microgrids. Revisions to the key standard IEEE 1547 will be developed to address grid interconnection issues and enable islanding and ride-through (continued operation) of distributed energy resources and microgrids. In FY13, the focus will be to establish a laboratory testbed to perform metrology and interoperability testing of smart grid-enhanced PCS functions for grid interconnection of distributed energy resources and microgrids. In FY14-15, the project will develop and evaluate measurement methods and procedures to support industry interoperability testing of these PCS systems and measurements of advanced smart grid PCS component technologies under development.

Program Area: Measurement Science for User-to-Grid Interoperation
Within this thrust area, the Building Integration with Smart Grid project is developing underpinning measurement science necessary to integrate customer facilities with a smart grid, through development of high impact industry standards, industry-run testing and certification processes, and new industry best practices. This includes improving and expanding consumer access to their energy usage information (via the Green Button), and standardization of communications between the smart grid and new electric vehicles, whose charging within communities must be scheduled and managed to avoid overloading local distribution transformers. In FY13-14, this project will develop new industry standards and practices that will support a radical market transformation in building system design and operation, including integrating building automation systems with the smart grid, development of facility smart grid information models and enhancements to smart grid communication protocol standards applicable to facilities. These control strategies and standards will enable a transition to a new era of real-time electricity pricing, increased use of renewable energy sources, building electrical load management, and interaction with engaged consumers through standardized format download access to their electric consumption data.

The Industrial Integration with Smart Grid project will develop the underpinning measurement science necessary to integrate industrial facilities with a smart grid. In FY13-14, the project will support integration of industrial automation systems with the smart grid, and harmonization of industrial and smart grid cybersecurity standards, including development of test procedures for ensuring conformance to security and performance standards. In this project, focused on the industrial control systems domain, there are natural interactions and coordination with the Cybersecurity for Smart Grid Systems project to ensure harmonization and applicability of guidance to industrial control systems.

Program Area: Smart Grid National Coordination

The Smart Grid National Coordination function within EL's Smart Grid and Cyber-Physical Systems Program Office carries out NIST's statutory responsibility to coordinate standards development for smart grid interoperability and provides programmatic leadership of NIST smart grid measurement science research in the Engineering Laboratory, the Information Technology Laboratory, and the Physical Measurement Laboratory. The National Coordination function provides national and global leadership to the smart grid community; liaises with Congress, the Executive Office of the President, DOE, FERC, state regulators, and other government agencies; administers the Smart Grid (Federal) Advisory Committee; and provides management oversight for the current SGIP administrator contract. A key focus in FY13 is to transition the SGIP into a self-sustaining legal structure funded primarily by the private sector, which will enable NIST to increase its effort on challenging measurement science research barriers that require NIST's unique capabilities to address. EISA directs NIST to submit a report to Congress on the smart grid as NIST deems appropriate; in FY14 a report will be developed on the NIST smart grid interoperability framework, covering accomplishments in development of standards for the smart grid, progress in deployment, and remaining challenges in measurement science supporting smart grid interoperability and cybersecurity.

How will teamwork be ensured? With leadership and program coordination from the EL Smart Grid and Cyber-Physical Systems Program Office, the smart grid program relies on contributions from approximately 20 NIST staff members in Engineering Laboratory, Physical Measurement Laboratory, and the Information Technology Laboratory. Weekly smart grid team meetings ensure coordination and communication, and provide a mechanism to raise and address the variety of measurement science and standards issues. Reviews of all projects within the program, and comprehensive program reviews have been held this year to provide input for management prioritization and program evolution, including upper management engagement and input on funding priorities from the three Laboratories. The integrated smart grid testbed under development will provide an additional mechanism to foster collaborative research teamwork.

What is the impact if successful? The National Science and Technology Council's "Policy Framework for a 21st Century Grid" enumerates six expected benefits from the NIST effort to catalyze development and adoption of open standards for the smart grid. The standards developed as a result of NIST's efforts will: help ensure that today's investments will be valuable in the future; will help catalyze innovation; will help support consumer choice; help lower price; highlight best practices as utilities face difficult choices; and help open markets. It is estimated that at least $400 billion will be spent on smart grid deployment over the next 20 years; the "future proofing" of these investments afforded by interoperability standards is critical to their cost-effectiveness and confidence of regulators in permitting deployment of smart grid technologies.

With successful program implementation, the overall impacts of the NIST smart grid program will address significant industry needs. The impact of improving systems-level smart grid performance will be coordination and validation of integrated modeling of systems and subsystems at different time scales and (communication) network environments. Industry will also benefit from stronger risk-management-based cyber security strategies to increase overall system reliability. Impact on transmission and distribution grid operations will be increased efficiency and greater reliability, as achieved through development of measurement science for improved real time monitoring and control, with state-of-the-grid sensor measurements available at grid operations centers with improved accuracy under typical field environments based on new NIST dynamical measurements methods and associated standards for sensing equipment. The national benefit will be greater visibility and coordination between electric utilities to minimize the extent of outages experienced by the public and faster recovery from the effects of extreme weather events. Improvements in grid reliability resulting from NIST measurement research will reduce the $80 billion cost to the US economy as a result of power outages.

To allow greater use of intermittent clean energy sources like wind and solar, new measurement science for distributed energy resources will support new standardization to enable greater use of power conditioning systems throughout the grid, and impact the sustainability of the grid over the long term. In addition, measurement science to support end-user interactions with the grid will enable automated responsive demand in customer facilities and residences, able to support grid operations by helping react to changing grid conditions and provide needed grid support services in addition to improved energy efficiency and greater management of energy use and costs by customers. An example of the rapid impact on innovation in this domain that can be achieved through NIST coordination of standards is the "Green Button Download My Data" capability, which will be deployed to 30 million consumers by 2013, enabling them to save electric costs through analysis of their energy use. Eighty percent of the market for smart grid devices and systems will be outside the US; the international harmonization of standards enabled by the NIST program opens this much larger market to US manufacturers.

What is the standards strategy? Smart grid standards are produced by over 25 different standards developing organizations (SDOs) at national and international levels, including IEC, IEEE, ITU-T, NAESB, NEMA, ASHRAE, and OASIS to name a few. A key objective of the program is to ensure these SDOs produce the specifications needed to realize the smart grid in the U.S. in a coordinated fashion while minimizing potential for duplication or conflict. The smart grid program has established both strategic relationships with senior leadership of the SDOs to ensure alignment on priorities and objectives, and tactical relationships to provide specific requirements that new standards or revisions to existing standards must meet. The SGIP Priority Action Plan (PAP) process is the key methodology used to accomplish the latter.

The NIST Interoperability Framework provides significant detail on the program's standards engagement process, strategy, prioritization, timelines, and results. To evaluate these standards development efforts for SMART qualities, i.e. specific, measurable, attainable, relevant and timely involvement, below are corresponding attributes of the SGIP and NIST standards development process. Specific: Specific standardization needs for the smart grid are identified through multiple sources of input, including identification of specific standards gaps through use case analysis, with review by SGIP domain expert working groups. Measurable: Requirements are developed at the start of SGIP priority action plans to enable evaluation of results produced by standards setting organizations. Attainable: Priority action plans have defined standards deliverables and other output, and identify participation and commitment from lead standards setting organizations and other key individual participants. Relevant: Each priority action plan proposal is individually reviewed by the SGIP Governing Board for scope, structure, relevancy and anticipated impact, revised in collaboration with proposers, and each must pass a majority voting threshold of the Governing Board to be established. Timely: Each priority action plan has deliverables with timelines, and the SGIP project management office (PMO) tracks progress against deliverables and provides regular status reports to the Governing Board. In addition, key testing and certification programs with associated Interoperability Testing Certification Authorities supporting specific smart grid standards are also in development, based on guidance incorporated in the Interoperability Process Reference Manual, version 2, from the SGIP Testing and Certification Committee.

The prioritized standards needs as identified through this process include all of the existing open (not completed) priority action plans. Our “top” standards priorities includes the following list: (1) PAP20: Green Button ESPI evolution, which includes revision of North American Energy Standards Board energy usage information (REQ.18/WEQ.19) and energy service provider interface (REQ.21) standards in support of the Green Button Initiative, to provide electronic access to customer energy usage information in a common human- and machine-readable format [Note: additional explanatory details of these and other standards are provided in associated smart grid project descriptions.]; (2) PAP7: Energy Storage Interconnection Guidelines, which includes standardization of advanced power electronics functions within the Institute of Electrical and Electronics Engineers (IEEE) 1547 standard to support greater use of grid-interconnected distributed resources; (3) PAP19: Wholesale Demand Response (DR) Communication Protocol, which is establishing common wholesale electric market interface profiles (based on several existing standards) to support pricing or grid condition communications; (4) PAP17: Facility Smart Grid Information Model, which includes standardization within the joint American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)/NEMA 201P effort to represent the information necessary to manage electrical generation and consumption in a home, office building or commercial facility; (5) the new International Electrotechnical Commission (IEC) Project Committee 118 (P118) smart grid user interface standardization effort; (6) PAP13: Harmonization of IEEE C37.118 with IEC 61850 and Precision Time Synchronization, in which these standards are aligned to enable wide-area communication, collection and use of time-stamped grid operational data (phasor measurement unit data); and (7) cybersecurity and other technical reviews of these and other standardization efforts within the SGIP.

How will knowledge transfer be achieved? A key method for knowledge transfer to industry is through NIST work with the SGIP and its member organizations, through direct interactions with relevant SGIP expert groups, NIST leadership of SGIP PAPs, specific NIST contributions to SGIP work products, and active, visible participation in SGIP workshops. The SGIP is the primary standards coordination mechanism for industry, and with significant industry participation (over 750 organizations in the SGIP) it serves as an excellent mechanism both for collective knowledge transfer to industry broadly and also one-on-one technical interactions on issues of mutual interest. Knowledge transfer is also accomplished through direct outreach to key groups such as state regulators (individually and through NARUC), testing and certification organizations, and trade associations. Other mechanisms of knowledge transfer include leadership and participation in additional conferences and workshops, technical publications (including publication of NIST-RASEI workshop results), coordination and development of new or enhanced industry standards and guidelines, and through project-focused collaborative work with industrial and academic partners.

MAJOR ACCOMPLISHMENTS

Outcomes:

- NIST Smart Grid Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0 (January 2010) and Release 2.0 (February 2012): These authoritative Framework documents are the primary NIST output fulfilling its EISA role, providing to the U.S. and world smart grid industry the high-level guidance on architectural and cybersecurity principles, standards, and testing and certification based on consensus industry input supported by a comprehensive public review process.
- New private/public organization: Smart Grid Interoperability Panel (SGIP, established in November 2009) With over 750 member organizations and significant international participation, the SGIP is recognized as the leading worldwide organization and forum for smart grid standards coordination and testing and certification guidance.
- New or revised Smart Grid standards and guides: NIST-facilitated output from a variety of standards development organizations and other groups, including as part of priority action plans within the SGIP, have been developed and published, covering areas such as energy usage information, smart meters, electric vehicles, demand response, and guidelines for assessing wireless standards for smart grid applications.
- Cybersecurity guidelines and standards: These are NIST-facilitated or NIST Interagency Report output from NIST, the SGIP Cyber Security Working Group, and other groups. The primary NIST-facilitated contribution, NISTIR 7628 Guidelines for Smart Grid Cyber Security (Volumes 1, 2, and 3), provides an analytical framework that organizations can use to develop effective cyber security strategies tailored to their particular combinations of smart grid-related characteristics, risks, and vulnerabilities.
- Testing and certification methods and tools: NIST-facilitated output includes the Smart Grid Interoperability Panel (SGIP)-published Interoperability Process Reference Manual (IPRM), Version 2.0, which provides recommendations on processes and best practices that enhance the introduction of interoperable products into smart grid markets.
- Measurement methods and tools: Development of these methods and tools result in a variety of publications, guides, and models covering areas including synchrophasor, advanced meters, time synchronization, building-to-grid and other testbeds, and system performance models.

Recognition of EL:

NIST SG Federal Advisory Committee report, March 2012
“NIST’s work to establish Smart Grid interoperability protocols and standards has been carried out both methodically and with a sense of urgency, and NIST is to again be commended for the enormous task it has undertaken and for its many accomplishments over the last two and a half years”

Federal Energy Regulatory Commission, July 2011

"We believe that the best vehicle for developing smart grid interoperability standards is the NIST interoperability framework process, including the work of the SGIP and its committees and working groups…The Commission recognizes and appreciates the comprehensiveness of the smart grid interoperability framework process developed by NIST… we encourage utilities, smart grid product manufacturers, regulators, and other smart grid stakeholders to actively participate in the NIST interoperability framework process to work on the development of interoperability standards and to refer to that process for guidance on smart grid standards"

Substantial positive media coverage, available through NIST News Clips dissemination

2011 Gold Medal for NIST smart grid team members, for developing a globally-recognized smart grid standards framework enabling transition to a clean energy economy and increased U.S. competitiveness.

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[1] Energy Independence and Security Act of 2007 [Public Law No: 110-140], available at http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf

[2] The White House, Office of the Press Secretary, "Remarks by the President in State of the Union Address." January 25, 2011 and January 24, 2012. See http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address and http://www.whitehouse.gov/the-press-office/2012/01/24/remarks-president-state-union-address

[3] The White House, "Blueprint for a Secure Energy Future." March 30, 2011, available at http://www.whitehouse.gov/sites/default/files/blueprint_secure_energy_future.pdf

[4] National Science and Technology Council, "A Policy Framework for the 21st Century Grid: Enabling Our Secure Energy Future." Available at http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc-smart-grid-june2011.pdf

[5] Understanding the Cost of Power Interruptions to U.S. Electricity Consumers, LBNL-55718, available at http://certs.lbl.gov/pdf/55718.pdf

[6] NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0 and Release 2.0, available at http://www.nist.gov/smartgrid/upload/FinalSGDoc2010019-corr010411-2.pdf and http://www.nist.gov/smartgrid/upload/NIST_Framework_Release_2-0_corr.pdf

[7] NISTIR 7628 Guidelines for Smart Grid Cyber Security, available at http://www.nist.gov/smartgrid/upload/nistir-7628_total.pdf

[8] Energy Independence and Security Act of 2007 [Public Law No: 110-140], Sec. 1305, available at http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf